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ABSTRACT

This paper presents some possible reasons why persons with visual impairments are under-represented in the fields of mathematics and science, including insufficient general preparation for higher education during the K-12 years and the lack of effective alternative instructional materials and methods available to a person with a visual impairment in math and science once they reach college. A four-unit graduate course entitled "Adaptive Technology and Visual Impairments," located at California State University, Fullerton, is described. This innovative teacher preparation course is designed to address this under-representation by providing future teachers of the visually impaired with 55.5 hours of hands-on, computer-based adaptive technology instructional training and an additional 19.5 hours of an applied technology practicum. Topics to be covered in the course include electronic notetakers, tactile graphics, computer-generated braille transcription, and computer screen access programs. The purpose of this four-year project is to better train teaching professionals who work directly with students with visual impairments in K-12 in the use of adaptive technology and in doing so, to improve the K-12 students' general literacy and technical skills related to compensatory technologies, thus better preparing them for success in postsecondary education. (CR)

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BUILDING A BRIDGE TO COLLEGE Success IN K-12

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Abstract

This paper presents some possible reasons why persons with visual impairments are under represented in the fields of mathematics and science and describes an innovative program to improve this situation in the future.

Introduction

When researching the relationship between the under representation of persons with disabilities in the fields of mathematics and science and kindergarten through twelfth grade (K-12) education, university professors in mathematics and science were informally asked to describe the impact the K-12 grades had on their professional career paths. While they didn't feel their K-12 years directly contributed to their present field in terms of specific math or science study, they seemed to agree that their K-12 experiences provided them with the general literacy foundation they needed to be successful once they entered postsecondary education and began their specific math or science studies.

One mathematician said she felt it was more a matter of K-12 not deterring her from the option of studying math in higher education and that she had actually started college as a history major. She felt that by having a solid foundation in multiple subjects prior to entering college, her options for success in a variety of areas in postsecondary education were increased. A molecular biologist reported she intended on studying art when she graduated from high school and it wasn't until after she was in college that she became seriously interested in the biological sciences. Like the mathematician, she remarked that her ability to succeed in such a technical field as biology in college was due in part to having a strong background in basic literacy.

When asked if they thought having a disability would have had an effect on their career path, most felt it would depend on the disability. Generally speaking, it was felt that visual impairment or blindness would have the greatest effect on a person's ability to succeed in math or science because of the lack of availability of instructional tools and materials to effectively communicate information related to these disciplines. They felt access to information posed the greatest obstacle to success in math and science for a person with a disability.

The results of this informal survey concur with the author's personal and professional experience. That is, the leading causes of the under representation of individuals with visual impairments in the fields of

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mathematics and science are: 1) insufficient general preparation for higher education during the K-12 years; and, 2) the lack of effective alternative instructional materials and methods available to a person with a visual impairment in math and science once they reach college.

Although a discussion of the lack of effective alternative instructional materials and methods available to a person with a visual impairment in math and science is beyond the scope of this paper, it is important to note there are a number of innovative research projects currently investigating alternative methods for communicating mathematic and scientific information to individuals with visual impairments. Many of these projects are producing encouraging results particularly in the areas of auditory and tactile presentations of mathematic and scientific information.

Discussion of the Problem

Based on nearly ten years of professional experience working with students with visual impairments in community college and university settings, it is this author's opinion that the majority of students with visual impairments entering postsecondary education lack the literacy and technical skills necessary to successfully manage the challenges of mathematics or science in higher education. Evidenced by their performance, a high percentage of the students served by this author do not exhibit an appropriate level of competency in such areas as reading, writing, and effective utilization of compensatory tools and strategies. For example, many students who have some sight but are functionally blind and print disabled haven't been taught to read or write braille or how to effectively use another nonvisual alternative technique for written communication before entering college. This is a serious concern because college success, even at a minimal level, requires an advanced level of written communication skills.

For the past 30 years or so, many students in K-12 with visual impairments sufficient to prevent them from comfortably reading standard print have been systematically directed toward listening to audio tapes as a substitution for visual or tactile reading. While an audio tape may be able to communicate a sufficient level of information to enable forward progress through the lower grades, the important technical elements of written communication such as spelling and punctuation cannot be captured by listening alone. As a consequence, when many of these students reach college and a higher level of written communication becomes necessary, they find themselves without the skills to independently succeed.

Regardless of disability, all students need to have solid literacy skills to succeed in postsecondary education. Good written communication skills are foundational to advancement in higher education and for those who do not have them, college is certain to be a struggle. While the substitution of auditory tapes for the printed word might seem reasonable to communicate content information, it doesn't equal the effectiveness of actually reading print when it comes to contributing to a solid literacy foundation.

It is this author's opinion that reading and writing skills are much more effectively taught and learned when braille or electronic text (e-text) are substituted for standard print rather than audio tapes. Both of these alternatives are more robust in emulating the technical composition elements of a written language than an auditory translation. Braille provides the reader with direct tactual information about the composition such as format, spelling, and punctuation while e-text enables the user to control the communication of composition elements to suit their individual needs. For example, when reading or writing e-text using a computer the user can independently keep track of details related to document structure as well as request to have words spelled or punctuation spoken or presented on a dynamic braille display at will. This method of reading much more closely emulates the amount of information available to a sighted reader.

This author along with other professionals believe that an increase in the effective utilization of braille and e-text for reading and writing by this population throughout the K-12 grades could increase their literacy skills and enable them to be more successful in postsecondary education. But in order for this to

happen, a system-change at the K-12 level will need to occur. To this end, an innovative approach to addressing this need for change will be launched in the summer of 1998, as part of the Teacher Credentialing Program for Teachers of the Visually Impaired at California State University, Los Angeles (CSLA).

Description of an Innovative Solution

Under the direction of Dr. Jamie Dote-Kwan, Coordinator of the Teacher Training Program in Visual Impairment and Blindness at CSLA, a new Special Topics teacher preparation course entitled Adaptive Technology and Visual Impairments will be offered. Funded as part of a U.S. Department of Education Personnel Preparation Grant, this four unit graduate course will provide future teachers of the visually impaired with 55.5 hours of hands-on computer-based adaptive technology instructional training and an additional 19.5 hours of an applied technology practicum.

Topics to be covered in the course include: electronic notetakers, tactile graphics, computer-generated braille transcription, and computer screen access programs. The purpose of this four year project is to better train teaching professionals in the use of adaptive technology who work directly with students with visual impairments in K-12 and in doing so, improve these K-12 students' general literacy and technical skills related to compensatory technologies thus better preparing them for success in postsecondary education.

Although course credit will be given through the Division of Special Education at CSLA, this 75 hour hands-on workshop will be taught at California State University, Fullerton's (CSUF) Computer Access Lab (CAL) and Braille Transcription Center (BTC). These sites have been selected for their summer availability and state-of-the-art adaptive computer technologies. The instructional team will be comprised of four specialists. Dr. Jamie Dote-Kwan, Co-Author of the Braille'n Speak Teaching Curriculum and Co-Director of the BTC will provide 13 hours of electronic notetaker (Braille'n Speak) instruction. Judie K. Kelly, National Library Service Certified Braille Transcriber and Tactile Graphics Specialist will present 6.5 hours of hands-on training in the creation of tactile graphics and the use of the Tactile Image Enhancer from ReproTronics, Inc.

The additional two areas of course instruction, computer-generated braille transcription and computer screen access programs will be presented by Vivian B. Lac, BTC Coordinator and Jeffrey C. Senge, CSUF Information & Computer Access Program Coordinator and BTC Co-Director, respectively. In collaboration with other instructional team members, Ms. Lac will provide those enrolled in this course with 19.5 hours of hands-on training in the preparation of computer-generated braille documents. This portion of the training will take place in the BTC, a computer-based braille production facility established to produce braille documents for students on the 22 campuses of the California State University System. Objectives include, data entry via keyboard and scanner using optical character recognition (OCR), editing of files, translating of files via computer braille translator, embossing, and proofreading finished documents for accuracy and usability.

The remaining 16.25 hours of instructional time will be spent in the CSUF CAL where Mr. Senge will train course participants in the use of computer screen access programs and adaptive technology for individuals with visual impairments. Participants will be expected to demonstrate a moderate level of proficiency using screen reading and screen magnification programs as well as OCR/reading machine technology. Specific methods of integrating the various technologies to accomplish practical tasks will be emphasized. In addition, the trainees will learn effective strategies for implementing these technologies into a K-12 student's educational curriculum.

The final 19.25 hours of the course will be devoted to a Application of Technology Practicum where the newly trained teachers will have an opportunity to demonstrate what they have learned to K-12 students. A group of students with visual impairments from neighboring K-12 school districts will be invited to

come to CSUF and participate in a week-long adaptive technology training program. The trained teachers will provide the direct instruction to the students and the four instructor specialists will supervise the trained teachers throughout the practicum. In addition to providing valuable first-hand training experience for the teachers, it is believed that the extended visit to a major university campus by the selected K-12 students with visual impairments for adaptive technology training will have a positive effect on their future educational or employment considerations. For some of these students, it may open a new world of possibilities.

Final Comments

Many students with visual impairments are leaving high school without the literacy skills they need to succeed in postsecondary education. The substitution of audio tape translations for written materials throughout the K-12 grades may be contributing to this deficiency. Audio tape translations do not generally communicate technical aspects of the written language sufficiently to reinforce good literacy skills resulting in a decreased exposure to compositional elements to the reader. Some of these literacy deficiencies may be more effectively addressed through earlier implementation of adaptive technology. For example, computer-based technologies provide the reader direct access to compositional elements such as document structure, spelling, and punctuation. These compositional elements are foundational to good literacy skills and should be mastered by students during their K-12 years.

The innovative teacher training program described in this paper focuses on increasing teacher's awareness and confidence related to adaptive technology for individuals with visual impairments in K-12. The course is designed to fully engage the teacher's involvement in its application and understand its relevance to addressing the literacy issue described above. Through this process of making teachers more aware of available adaptive technology and its role in improving student literacy in the K-12 grades, it is anticipated that future high school graduates with visual impairments will be better prepared to enter postsecondary education. Once students with visual impairments routinely enter college with the level of literacy and technical skills they need to succeed and postsecondary education provides a sufficient level of accessibility to technical programs, it is expected that there will be increased representation of this population in the fields of mathematics and science.